ON FLIGHT.

By R. von Lendenfeld, Ph.D.

The locomotion of animals has been the topic of an ever increasing number of papers since Marey published his unparalleled book (1) on this subject. Of all the different modes of locomotion none is so interesting as flight, because the organs adapted for this function are much more highly developed than any other locomotive organs.

In studying this subject one would naturally assume that the size of the wings was in proportion to the weight of the body, and that an animal would fly the better, the larger the relative size of the wings. It has however, been shown by myself and others, that this is by no means the case, and that an insect the relative size of whose wings is equal to the relative size of the wings of a swallow, cannot fly (grasshoppers, Dytiscus, &c.)

I have explained this fact by asserting that the very short wings of small animals would require a rapidity of motion, to have the same effect as the long wings of large animals, which is altogether incompatible with the celerity of the muscular contractions, and which has not been observed by Marey, who measured the number of wing-flaps per minute, nor by myself, who measured the extent of the angle which is passed through by the moving wing. I have previously asserted that the resistance of the air to flight was equal to C^3 that is the cube of the rapidity. The rapidity in itself is of course a factor depending not only on the rapidity of the wing-flaps and their angles, but also on the length of the wing increasing in proportion to the latter.

All these statements have been laid down in an essay published some years ago by me (2.)

(1) *Marey.* Locomotion animale, International Scientific Series.
(2) *V. Lendenfeld.* Der Flug der Libellen Sitzungsberichte der Kais. Academie der Wissenschaften in Wien. Band 81.

Several writers have since then dwelt on the subject of flight. Of these the careful essay of Müllenhoff (1) requires our especial attention.

Although Müllenoff dwells on his dissent from my views extensively, he acknowledges the correctness of my deduction referred to above, by stating that the correlation between the rapidity of wing-flaps and weight of the body can be expressed by asserting that the "centre of resistance" always moves with nearly the same velocity.

Among his numerous valuable statements, I will particularly refer to his ingenious, and doubtlessly to a great extent correct explanation of the mode in which eagles and vultures can rise by describing circles in the air without the movement of their wings. His explanation is the following:—He says the bird moves with the wind, with his head turned to the direction to which the wind blows *downward*, and moves in the opposite direction with his head facing the wind *upward*. The force which enables the bird to rise higher when he is moving against the wind than he has sunk when he was moving with the wind, is derived from the feathers being raised from the body when the bird moves with the wind, when the wind comes from behind, and that these feathers lie close to the body, so that it presents a much smaller surface when the bird moves against the wind. At the same time Müllenhoff asserts that the bird moves with the wind, describing a screw-line, following the surface of an inclined cylinder, in the direction of the wind. I think that this explanation is a most ingenious one, but I would at the same time like to submit, that it appears highly probable that the bird moves its wings at the same time round the axis of the forearm in such a manner as to catch the wind on the *lower* surface which ever way it moves. I have very often observed, through a telescope, eagles and hawks rising in a slight breeze, and believe that these birds change the position of wings and tail as they move round and round in

(1) *Müllenhoff.* Die Grösse der Flugflächen Pflügers Archiv für die Gesammte Physiologie. Band XXXV

such a manner that the wind *always tends to force the bird upwards*, and that the bird never sinks at all. Of course the bird is carried faster along with the wind the quicker it rises.

NOTES AND EXHIBITS.

Mr. C. S. Wilkinson exhibited some Fossil Bones which had been recently obtained from the coral sand rock on Lord Howe Island. Amongst them was an almost complete skull somewhat resembling that of the Horned Lizard *Megalania prisca*, from the Pleistocene deposits on the Darling Downs, Queensland.

Mr. Wilkinson also exhibited specimens of Shells of oysters found in the beds of clay and sand at a depth of 40 feet below the surface, in sinking the new shaft of the Bullock Island and Wickham Coal Company near Newcastle. Mr. Brazier identified this oyster, which must have been 12 inches in length, as a large form of the *Ostræa edulis*.

Dr. J. C. Cox exhibited other specimens of the *Ostræa edulis* from Port Jackson, found firmly attached to a bottle. He pointed out the great difference between this oyster, which will not keep for more than a day, and the English native oyster, and suggested that they are of separate species. Mr. E. P. Ramsay mentioned that the same oyster in South Australia keeps well for many days, and was of opinion that they were the same as the *O. edulis* of England.

Mr. Ramsay exhibited a Fossil phalanx of *Palæorchestes*, from Wellington Caves, from the size of which he calculated that the animal must have stood about 15 feet high. Also some Devonian shells and corals from the same district, in which the lime had been replaced by silica, and which had been cleared from the matrix by the application of muriatic acid.